Computer simulations can be as effective as direct observation at teaching students

February 11 2010, by Jeff Grabmeier

Students can learn some science concepts just as well from computers simulations as they do from direct observation, new research suggests.

A study found that people who used computer simulations to learn about moon phases understood the concepts just as well - and in some cases better - than did those who learned from collecting data from viewing the moon.

The results suggest the use of computer simulations in science classes may be an effective and often less expensive and time-consuming way to teach some science concepts, said Kathy Cabe Trundle, lead author of the study and associate professor of science education at Ohio State University.

"These results give us confidence that computer simulations can be effective in the classroom," Trundle said. "But now we need to do further study to see if it works in others areas of science."

Trundle conducted the study with Randy Bell, associate professor of science education at the University of Virginia. Their study appears online in the journal Computers & Education and will be published in a future print edition.

While there have been many studies examining computer use in the classroom, most have only examined whether students find computers easy to use and enjoy using them.

The few studies that have examined whether computers are effective for learning content have had mixed results, Trundle said. This study is an improvement because it actually compares people who used a computer simulation with those who had more direct observations.

"Our expectation was that the computer simulation would be at least as effective as direct observation in teaching about moon phases," Trundle said.

"When we did our analysis, the simulation was just as effective in teaching two aspects of moon phases, and more effective in a third aspect. So we were excited by that."

Participants in the study were 157 pre-service teachers-- master's degree students who are in training to become early childhood teachers.

Studies have shown that the majority of people - including preservice students and the students they teach - do not understand the cause of moon phases.

This study examined how well these preservice teachers understood moon phases before and after taking a 10-week science methods course that included a unit on moon phases.

In contrast to traditional instruction, this class was inquiry-based, which meant that students learned from gathering data themselves -- either directly from viewing the moon or from the computer simulation. The participants then analyzed the data they gathered to identify patterns.

One class learned about moon phases using only a computer simulation, one group from nature alone, and a third group from both a computer simulation and nature.

The computer simulations were provided through a commercially available software program that allows users to visualize the movement of the sun and the moon through time from any point on Earth.

The researchers tested the participants' understanding before and after the class in three areas: knowledge of sequences of moon phases, the causes of moon phases, and the shapes of moon phases.

Before the class, none of the preservice teachers had a complete scientific knowledge of the moon phases.

But after the class, teachers in all three groups - computer simulation only, nature only and simulation and nature - dramatically improved their scores. Up to 98 percent of the teachers showed they understood moon phases after the class was completed.

Those who used only computer simulations did just as well as others in learning causes of moon phases and shapes of moon phases. But those who used the simulations were actually slightly more likely than others to understand the sequences of moon phases.

"We believe that the computer simulation was more effective at teaching moon sequences because the students who used it had a complete set of data," Trundle said.

"Those who observed the moon in nature didn't - there were cloudy days and nights and other reasons why they couldn't collect data every night they were supposed to."

The ability to collect all the available data is just one reason why computer simulations may be better for teaching some science concepts.

"Classroom teachers don't always have time to do nature-based

instruction," Trundle said. "In this case, computer simulations allow teachers to speed up instruction, which means students gather the same amount of data in a shorter period of time. It's faster, easier and much less frustrating."

Computer simulations may be especially important in teaching earth and space science, because it offers opportunities that aren't available in the real world. For example, the software program used in this study allows students to see how the earth looks from the moon or from the sun, giving them a better perspective on how the earth-moon-sun system interacts.

Trundle said computer simulations might also be effective in teaching introductory biology. For example, students can take part in simulated animal dissections, overcoming some of the ethical and practical concerns.

Simulations would also allow students to "see" microscopic or even sub-atomic particles, giving them a better understanding of how particles interact.

"We're finding that technology can help students learn and understand scientific concepts in a way that may be easier for teachers and just as effective for students," Trundle said.

Provided by The Ohio State University